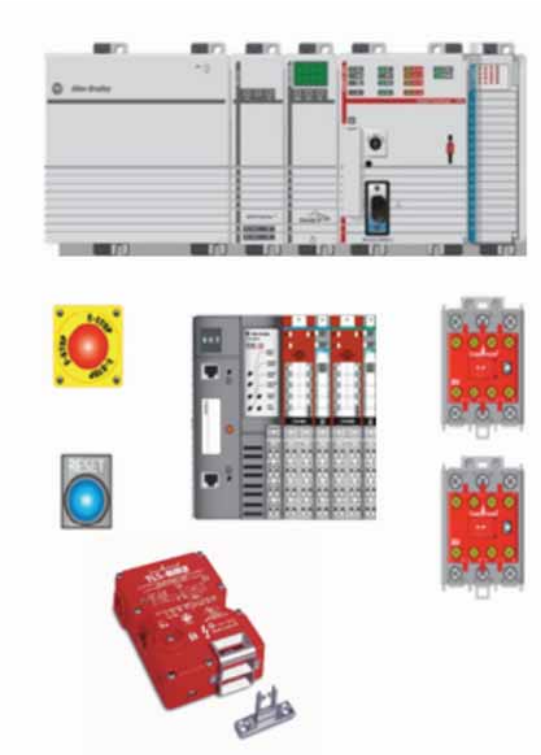


Safety Function: Door Locking and Monitoring
Products: TLS3-GD2
GuardLogix® Controller
POINT Guard Safety I/O™ Modules

Safety Rating: PLe, Cat. 4 to EN ISO 13849.1 2008

LISTEN.
THINK.
SOLVE.®

Allen-Bradley • Rockwell Software

Rockwell Automation

Table of Contents

Introduction	3
Important User Information	3
Safety Function Realization	4
General Safety Information	5
Setup and Wiring	7
Configuration	8
Programming	15
Falling Edge Reset	19
Calculation of the Performance Level	19
Verification and Validation Plan	21
Additional Resources	24

Introduction

This Safety Function application note explains how to wire, configure, and program a Compact GuardLogix® controller and POINT Guard I/O™ module to monitor and lock a TLS3-GD2 interlock switch mounted on a door. If the gate is opened or unlocked or a fault is detected in the monitoring circuit, the GuardLogix controller de-energizes the final control device, in this case, a redundant pair of 100S contactors.

This example uses a Compact GuardLogix controller, but is applicable to any GuardLogix controller. This example uses a TLS3-GD2 interlock switch, but is applicable to power to release locking switches with at least 2 N/C door contacts and at least one N/C lock contact.

Power to lock switches can utilize this document with one simple change in the ladder logic. This example assumes that the jumpers in the TLS3-GD2 switch have been removed, and that separate feedback is available for both the lock and the door.

The SISTEMA calculations shown later in this document would have to be re-calculated using the actual products.

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication **SGI-1.1** available from your local Rockwell Automation® sales office or online at **http://www.rockwellautomation.com/literature**) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

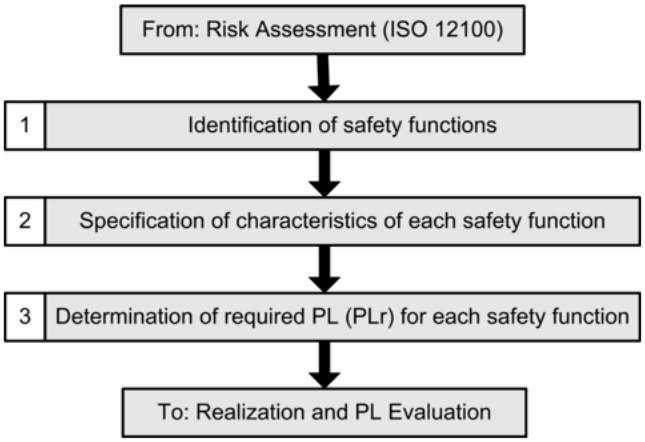
The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc., is prohibited.

Safety Function Realization: Risk Assessment

The required performance level is the result of a risk assessment and refers to the amount of the risk reduction to be carried out by the safety-related parts of the control system. Part of the risk reduction process is to determine the safety functions of the machine. For the purposes of this document the assumed required performance level is Category 4, PLe.


From: Risk Assessment (ISO 12100)
1
Identification of safety functions
2
Specification of characteristics of each safety function
3
Determination of required PL (PLr) for each safety function
To: Realization and PL Evaluation

Guard Locking Interlock Safety Function

The safety function is the removal of power from the hazard when the safety system detects that the door has been opened or that the lock has been energized.

Safety Function Requirements

Access to hazardous motion is prevented by using an interlocked guard door with guard locking. Once motor power has been removed, the guard door will remain closed and locked for a predetermined amount time to confirm the hazardous motion is stopped. At such time, the operator is allowed to unlock the door by applying power to the guard lock. While the door is open, it is monitored to confirm an unexpected start-up. Upon closing of the door, hazardous motion and power to the motor will not resume until a secondary action (start button depressed) occurs. Faults at the door interlock switch, wiring terminals or safety controller will be detected before the next safety demand. The stop time of the machine must be established such that the hazardous motion must be stopped before the user can reach the hazard. The safety function in this example is capable of connecting and interrupting power to motors rated up to 9A, 600VAC.

The safety function will meet the requirements for Category 4, Performance Level “e” (Cat 4, PLe), per ISO 13849-1, and SIL3 per IEC 62061, and control reliable operation per ANSI B11.19.

Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
	ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
	SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

General Safety Information

Contact Rockwell Automation to find out more about our safety risk assessment services.

IMPORTANT	This application example is for advanced users and assumes that you are trained and experienced in safety system requirements.
	ATTENTION: A risk assessment should be performed to make sure all task and hazard combinations have been identified and addressed. The risk assessment may require additional circuitry to reduce the risk to a tolerable level. Safety circuits must take into consideration safety distance calculations which are not part of the scope of this document.

Functional Safety Description

In this example, unlock is requested by placing a demand on a safety input interlock. The demand on the safety input drops out the redundant contactors, and the motion coasts to a stop. After a five second delay to allow the motion to completely stop, the gate unlocks. The TLS3-GD2 switch is wired to two pairs of safety inputs on a Safety Input module (SI1). One pair is the lock monitoring contacts and the other is the door monitoring contacts. The safety contactors (K1 & K2) are connected to a pair of safety outputs on a Safety Output module (SO1). The I/O module is connected via CIP Safety over an EtherNet/IP network to the Safety Controller (SC1). The safety code in SC1 monitors the status of the gate using the pre-certified safety instruction 'Dual Channel Input Stop with Test and Lock' (DCSTL). When all safety input interlocks are satisfied, no faults are detected, and the reset push button is pressed, a second certified function block called Configurable Redundant Output (CROUT) controls and monitors feedback for a pair of 100S redundant contactors. In summary, when a demand is placed on a safety interlock, the contactors drop out. Five seconds later, the gate unlocks. When the door is closed and locked, and the reset button is pressed, the contactors are energized.

Bill of Material

Catalog Number	Description	Quantity
440G-T27181	TLS3-GD2 Power to Release Safety Interlock Switch	1
800FM-G611MX10	800F Reset Push Button - Metal, Guarded, Blue, R, Metal Latch Mount, 1 N.O. Contact(S), Standard	1
100S-C09ZJ23C	Bulletin 100S-C - Safety Contactors	2
800FP-MT44PX02	800F Non-Illuminated Mushroom Operators, Twist to Release, 40mm, Round Plastic (Type 4/4X/13, IP66), Red, 2 N.C. Contacts	1
800F-15YE112	800F Legend Plate, 60mm Round, English: EMERGENCY STOP, Yellow with Black Legend Text	1
1768-ENBT	CompactLogix™ EtherNet/IP Bridge Module	1
1768-L43S	Compact GuardLogix Processor, 2.0 MB standard memory, 0.5 MB safety memory	1
1768-PA3	Power Supply, 120/240 VAC Input, 3.5 A @ 24V DC	1
1769-ECR	Right End Cap/Terminator	1
1734-AENT	24V DC Ethernet Adapter	1
1734-TB	Module Base with Removable IEC Screw Terminals	4
1734-IB8S	POINT Guard Safety Input Module	1
1734-OB8S	POINT Guard Safety Output Module	1
1783-US05T	Stratix 2000™ Unmanaged Ethernet Switch	1

Setup and Wiring

For detailed information on installing and wiring, refer to the product manuals listed in the **Additional Resources**.

System Overview

The 1734-IB8S input module monitors two door channels and two lock channels of the TLS3-GD2.

The 1734-IB8S module can source the 24VDC for all these channels to dynamically test the signal wiring for shorts to 24VDC and channel to channel shorts. If a fault occurs, either or both channels will be set LO, and the controller will react by dropping out the safety contactors. Only after the fault is cleared and the gate is cycled will the function block reset.

Shorts to 0V DC (and wire off) will be seen as an open circuit by the 1734-IB8S input module and the controller will react by dropping out the safety contactors. If the inputs remain discrepant for longer than the discrepancy time, then the function blocks in the controller safety task will declare a fault. Only after the fault is cleared and the gate is cycled will the function block reset.

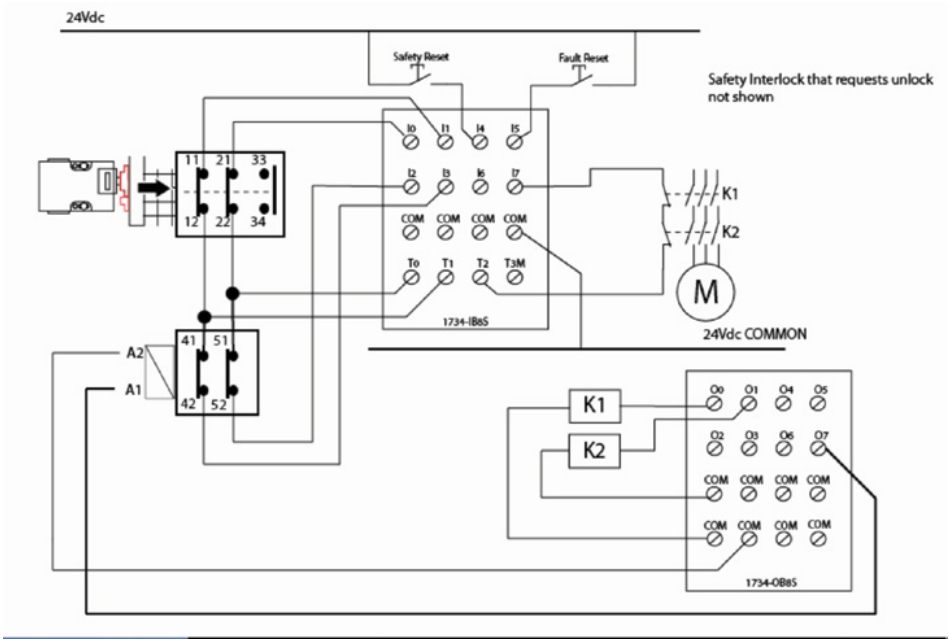
The final control device in this case is a pair of 100S safety contactors, K1 and K2. The contactors are controlled by a 1734-OBS safety output module. The contactors are wired in a redundant series configuration. A feedback circuit is wired through the N/O contacts and back to an input on the 1734-IB8S module to monitor the contactors for proper operation. The contactors cannot restart if the feedback circuit is not in the correct state.

The system has individual reset buttons for resetting faults and safety outputs.

Note that the reset buttons and the contactor feedback circuit are all wired to the 1734-IB8S module in this example. This is not required for functional safety. These three (3) inputs could be wired to a standard input module.

In this example, the gate solenoid is controlled by a safety output. This is not required for functional safety. The solenoid could be controlled by a standard output. If the solenoid were to fault LO, the gate will never unlock a rather safe state. If the solenoid were to fault HI; the gate will unlock, but unless the ‘motion stopped’ input is HI, the DCSTL instruction in the safety task will declare a fault and drop out its output. For these reasons, the solenoid is not a part of the safety function.

Electrical Schematic



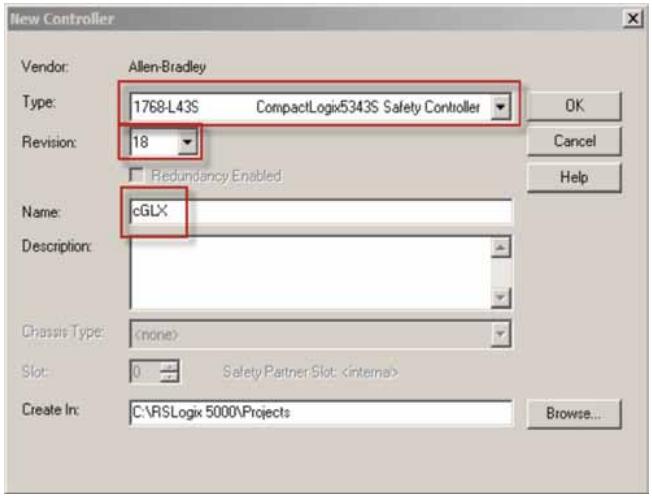
Configuration

The Compact GuardLogix controller is configured by using RSLogix™ 5000 software, version 17 or later. You must create a new project and add the I/O modules. Then, configure the I/O modules for the correct input and output types. A detailed description of each step is beyond the scope of this document. Knowledge of the RSLogix programming environment is assumed.

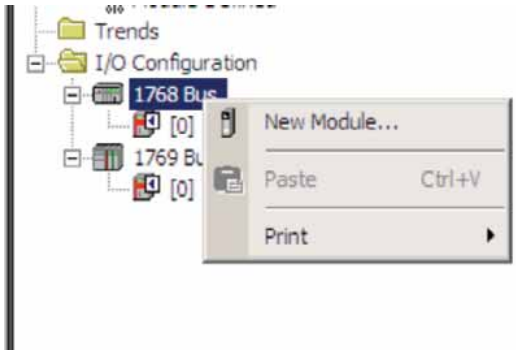
Configure the Controller and Add I/O Modules

Follow these steps.

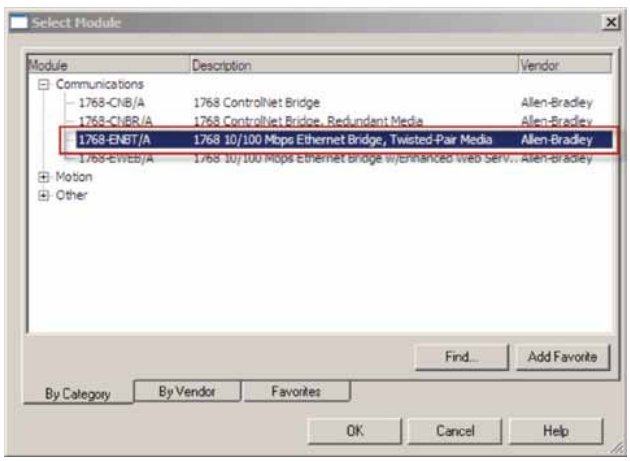
1. In RSLogix 5000 software, create a new project.



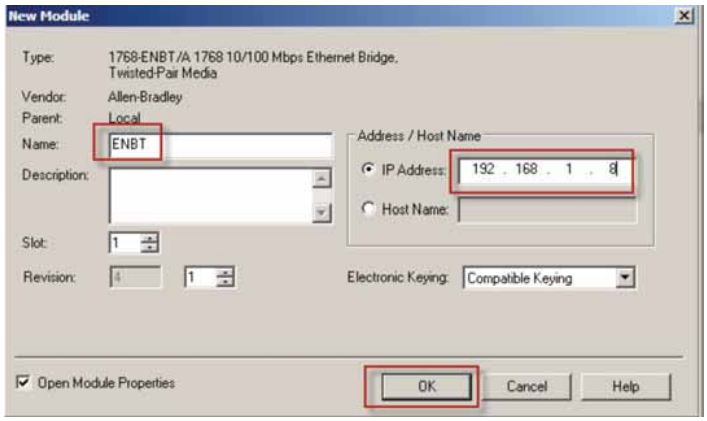
2. In the Controller Organizer, add the 1768-ENBT module to the 1768 Bus.



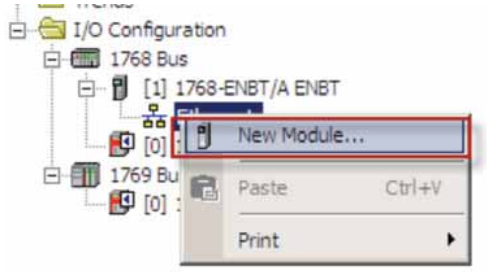
3. Select the 1768-ENBT module and click OK.



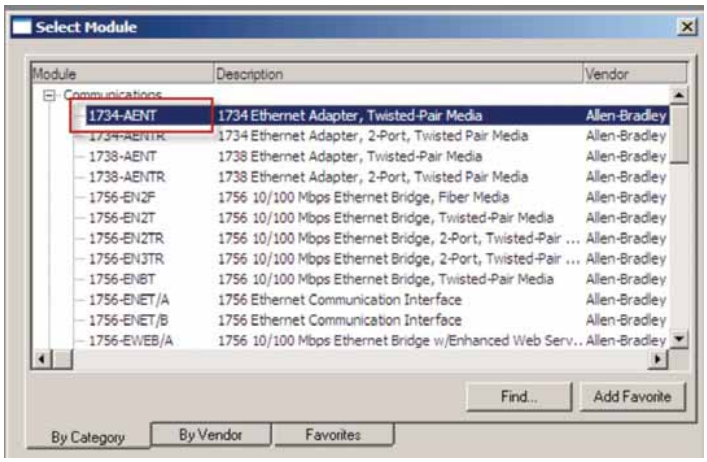
4. Name the module, type its IP address, and click OK.
   We used 192.168.1.8 for this application example. Yours may be different.



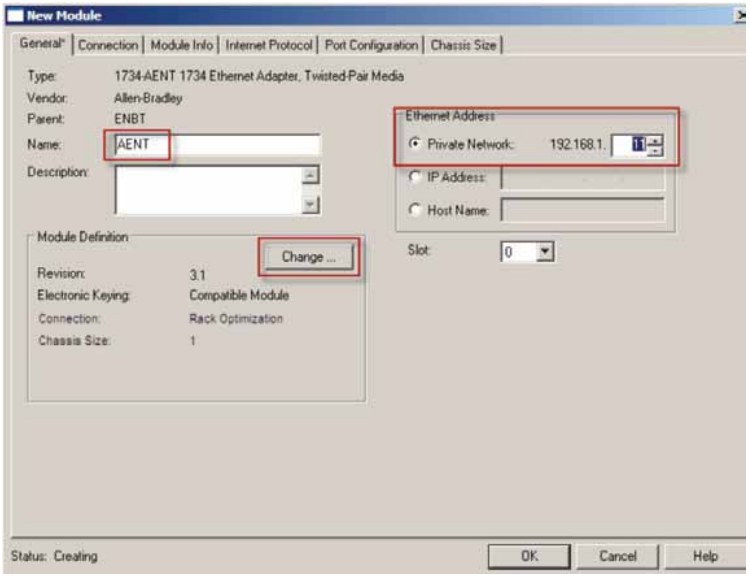
5. Add the 1734-AENT adapter by right-clicking the 1768-ENBT module in the Controller Organizer and choosing New Module.



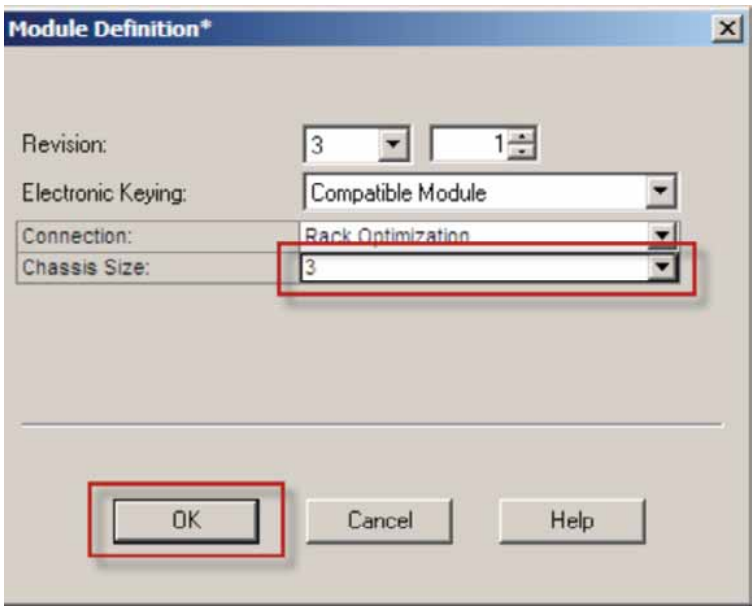
6. Select the 1734-AENT adapter and click OK.



7. Name the module, type its IP address, and click OK.
   We used 192.168.1.11 for this application example. Yours may be different.
8. Click Change.

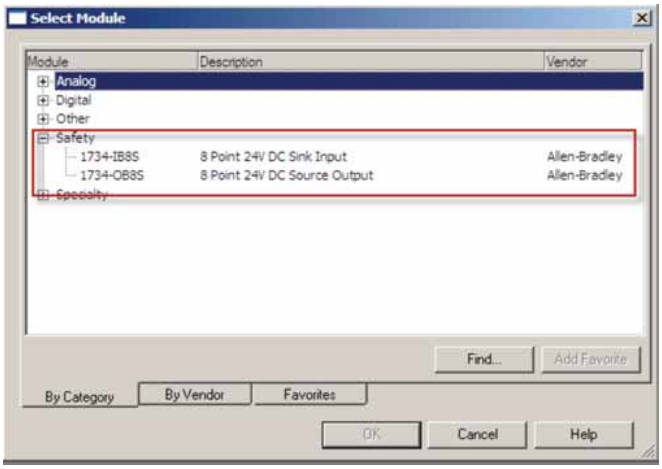


9. Set the Chassis Size as 3 for the 1734-AENT adapter and click OK.
   Chassis size is the number of modules that will be inserted in the chassis. The 1734-AENT adapter is considered to be in slot 0, so for one input and one output module, the chassis size is 3.



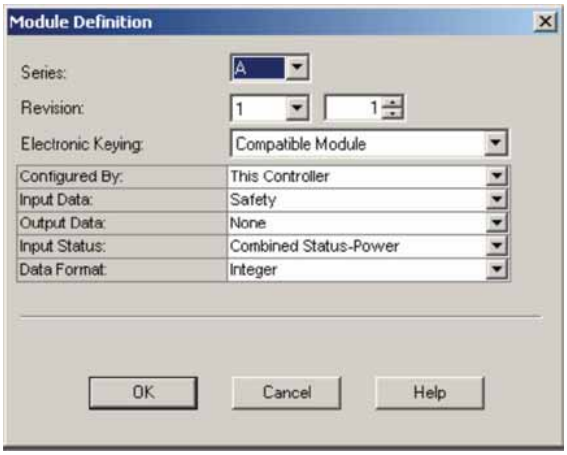
10. In the Controller Organizer, right-click the 1734-AENT adapter and choose New Module.

11. Expand Safety, select the 1734-IB8S module, and click OK.



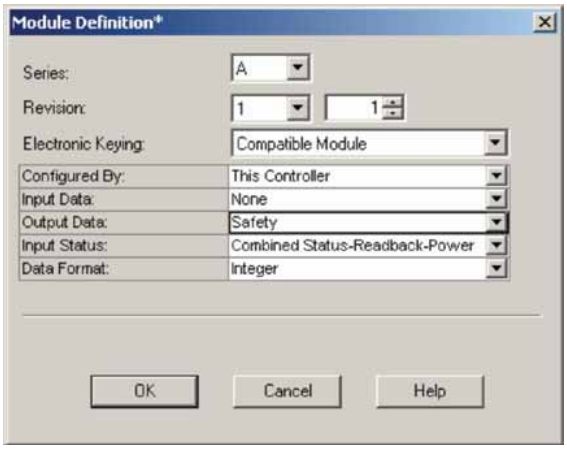
12. In the New Module dialog box, name the device 'IB8S'and click Change.

13. When the Module Definition dialog box opens, change the Output Data to 'None' and verify the Input Status is Combined Status-Power', and click OK. Setting the output data to None means that you cannot use the Test Outputs as standard outputs, and we are not doing that in this example. Note this saves one (1) controller connection because we are only using the input connection.



14. Close the Module Properties dialog box by clicking OK.

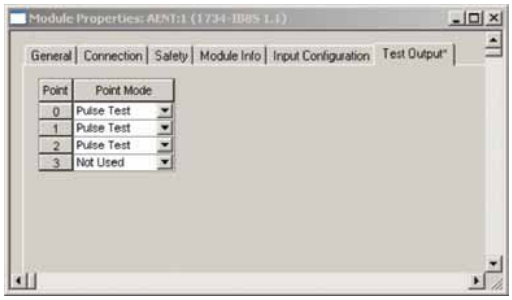
15. Repeat steps 10-14 to add the 1734-OB8S safety output module. Name the module OB8S. Note this module will be in slot 2, and select 'Combined Status-Readback-Power' for Input Status definition.



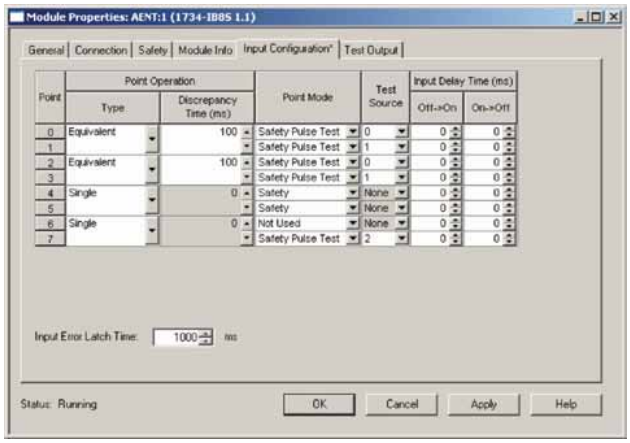
Configure the I/O Modules

Follow these steps to configure the POINT Guard I/O modules.

1. In the Controller Organizer, right-click the 1734-IB8S module and choose Properties.
2. Click Test Output and configure the module as shown. T0 and T1 are being used to pulse test the TLS3-GD2 channels. T2 is being used to pulse test the contactor feedback circuit.

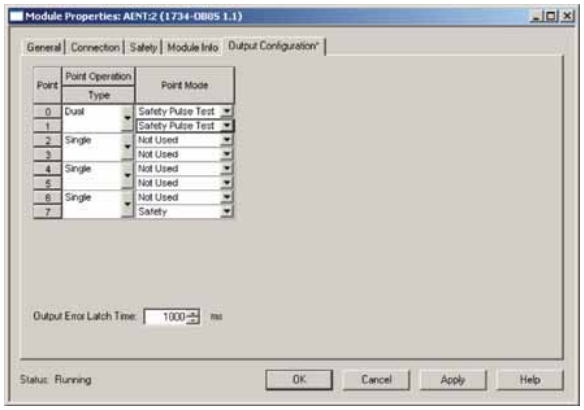


3. Click Input Configuration and configure the module as shown. Inputs 0/1 are the TLS3-GD2 door monitoring contacts. Recall that inputs 0/1 are being sourced from test outputs 0/1. Inputs 2/3 are the lock monitoring contacts. They are also being sourced from test outputs 0/1. Inputs 4/5 are the reset buttons. Input 7 is the contactor monitoring circuit. Recall that input 7 is being sourced from Test Output 2. Note that there really is no difference when an input channel is configured for safety or standard. It is used more for documentation.



4. Click OK.
5. In the Controller Organizer, right-click the 1734-OB8S module and choose Properties.

6. Click Output Configuration and configure the module as shown. The electromechanical coil on the contactor (outputs 0/1) can be pulse tested without reacting to the brief LO pulse. Output 7 is the TLS3-GD2 locking solenoid.



7. Click OK.

Programming

The Dual Channel Input Stop with Test and Lock (DCSTL) instruction monitors and locks dual channel safety devices whose main function is to stop a machine safely. For example, a safety gate with locking solenoid. When the 'unlock request' goes HI, the DCSTL instruction waits for the 'Hazard Stopped' input to go HI, and then turns on the ULC (unlock command) output. At the same time, the output (O1) goes LO to indicate that the gate is no longer protecting the hazard. The Lock Feedback should go LO, indicating the gate is indeed unlocked. The operator can now open the gate. Note that the DCSTL requires that the door monitors (Channel A and Channel B) cycle at this time or a fault occurs when restart is attempted. This cycle can be done by opening or closing the gate or can be done in software as shown later in this section.

In this example, the unlock request is generated by placing a demand on the safety interlock being controlled by the DCS instruction. For your application, all that is required is that unlock request be set LO. The demand on the safety interlock drops out the safety contactors, and 5 seconds later the 'hazard stopped' tag is set HI. This causes the DCSTL instruction to set the ULC output which energizes output 7 and unlocks the gate. Your application needs to determine the proper way to generate the 'hazard stopped' tag.

There are two (2) lock monitoring contacts on the TLS3-GD2 switch, yet there is only one (1) lock feedback tag required for the DCSTL instruction. The DCM instruction is used to monitor both lock contacts, and its output used for the DCSTL 'lock feedback' tag.

The DCSTL, DCM and DCS instructions monitor their respective dual-channel inputs for consistency (Equivalent – Active High) and detect faults when the inconsistency is detected for longer than the configured Discrepancy Time (ms).

The automatic restart type allows the DCSTL and DCS outputs (O1) to reset automatically after a demand. The manual action typically required for safety is provided in rung 6 to reset the safety output enable.

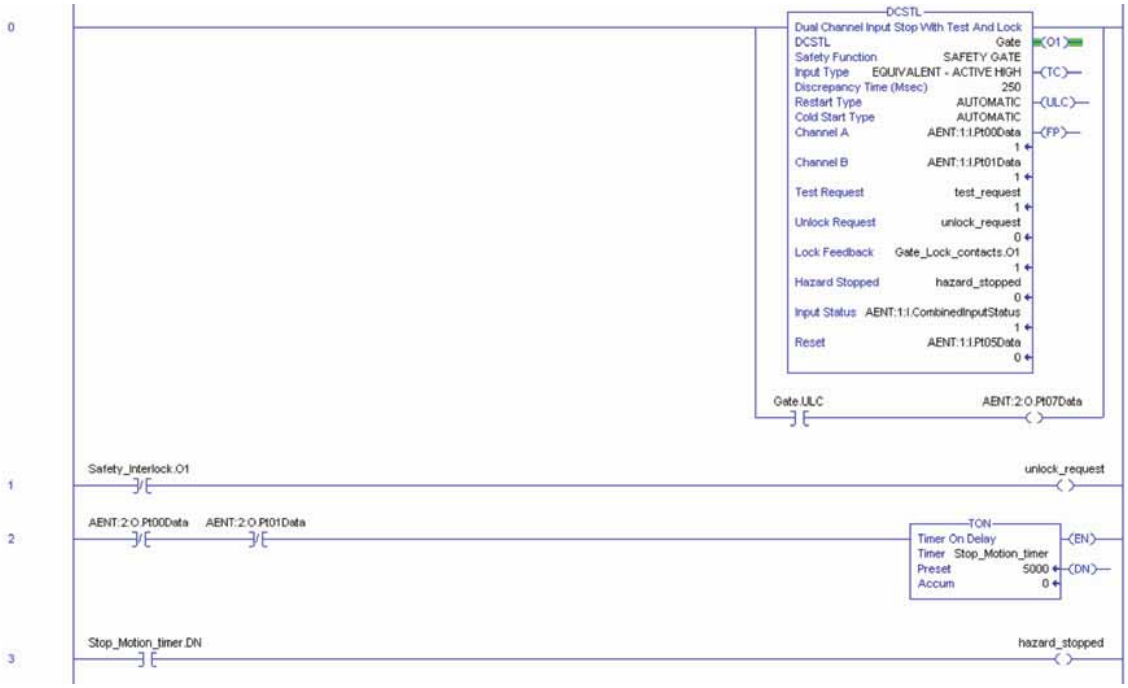
Input Status typically represents the channel status of the two input channels. In this example, the 'Combined Input Status' bit goes LO if any of the 8 input channels on the 1734-IB8S module has a fault.

In this example, the DCSTL, DCM and DCS reset acts as a fault reset. Even when configured for automatic restart, a reset is required to recover from a fault.

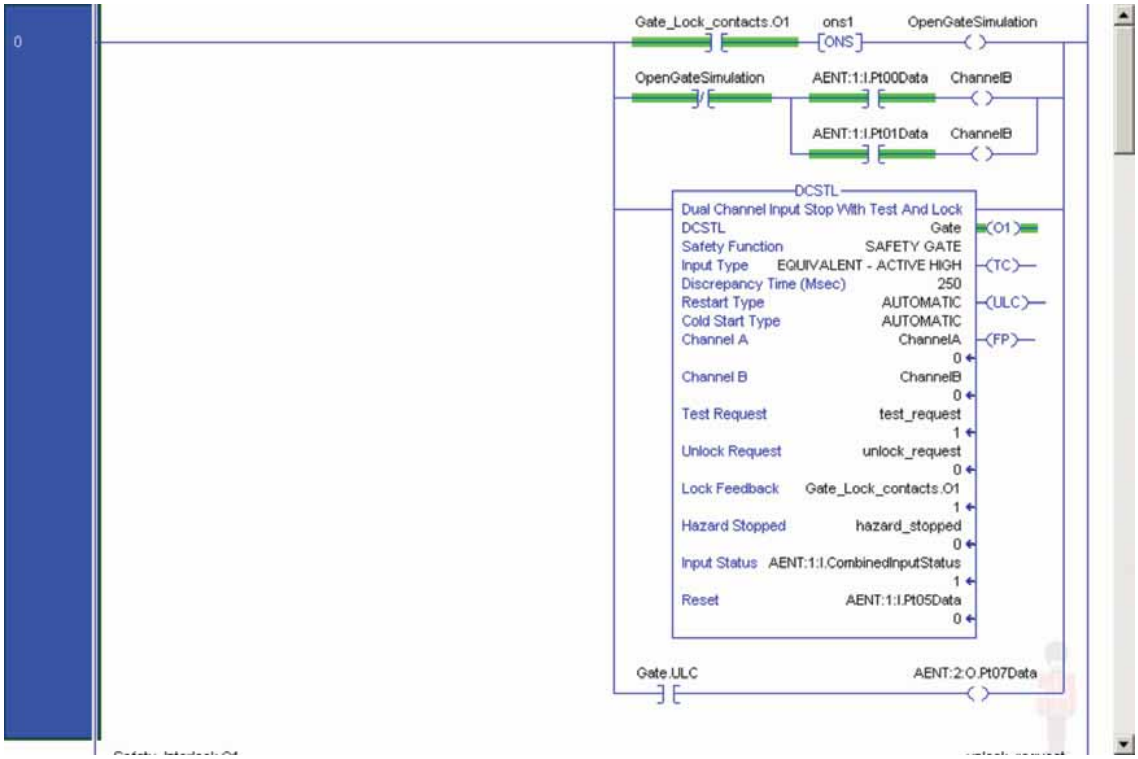
The outputs (O1) of the DCSTL, DCM and DCSD instructions are used as a safety interlock in the seal-in rung to drive the output enable tag. If any of the three (3) outputs drop out, so does the output enable, and it will remain off until a manual reset action is carried out.

The Configurable Redundant Output (CROUT) instruction controls and monitors redundant outputs. Essentially this instruction verifies that feedback follows the safety outputs appropriately. For the negative feedback used in this example; if the outputs are HI, the feedback should be LO and vice versa. In this example, the feedback has 500ms to change to the proper state. Since only a single feedback circuit is being used, the feedback tag is used for both Feedback 1 and 2.

The two (2) output tags from the CROUT instruction are used to drive the contactor outputs on the 1734-OB8S module.



If you wish to use software to programmatically cycle Channel A and Channel B on the DCSTL, the following code is an example of how to accomplish this. Whenever the lock feedback goes LO, for one scan Channel A and Channel B are logically dropped out to satisfy the DCSTL requirements to cycle the gate. For the rest of the time, the two door monitoring contacts drive the state of Channel A and Channel B.


0
Gate_Lock_contacts.O1
ons1
ONS
OpenGateSimulation
OpenGateSimulation
AENT:1:I.Pt00Data
ChannelB
AENT:1:I.Pt01Data
ChannelB
DCSTL
Dual Channel Input Stop With Test And Lock
DCSTL
Gate
O1
Safety Function
SAFETY GATE
Input Type
EQUIVALENT - ACTIVE HIGH
TC
Discrepancy Time (Msec)
250
Restart Type
AUTOMATIC
ULC
Cold Start Type
AUTOMATIC
Channel A
ChannelA
FP
0
Channel B
ChannelB
0
Test Request
test_request
1
Unlock Request
unlock_request
0
Lock Feedback
Gate_Lock_contacts.O1
1
Hazard Stopped
hazard_stopped
0
Input Status
AENT:1:I.CombinedInputStatus
1
Reset
AENT:1:I.Pt05Data
0
Gate.ULC
AENT:2:O.Pt07Data

Falling Edge Reset

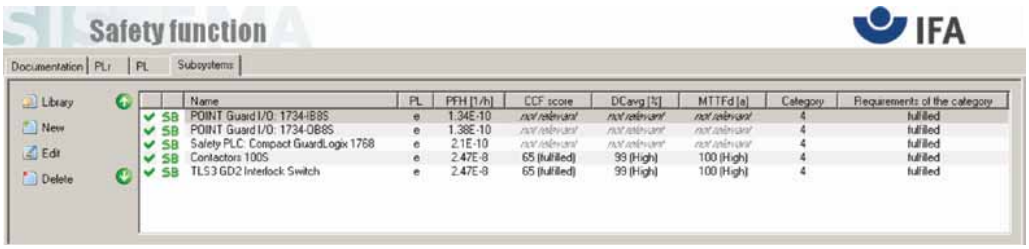
ISO 13849-1 stipulates that instruction reset functions must occur on falling edge signals. To comply with this requirement, a One Shot Falling instruction is used on the reset rung. Then the OSF instruction Output Bit tag is used as the reset bit for the Output Enable rung.

Calculation of the Performance Level

When configured correctly, this Door Monitoring and Locking safety function can achieve a safety rating of PLe, Cat. 4 according to EN ISO 13849.1 2008.

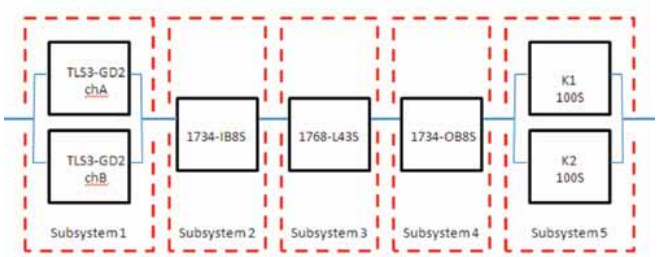
The Functional Safety Specifications of the project call for a Performance Level on PLd (minimum) and a structure of Cat 3 (minimum). A PFHd of less than 1.0 E-06 for the overall safety function is required for PLd.

The individual subsystem values are shown below.



The overall safety function value is shown below.

The Guard Door Monitoring and Locking safety function can be modeled as shown in the following safety related block diagram.



Calculations are based on 1 operation of the safety guard door per hour; therefore 8,760 operations of contactors per year.

The measures against Common Cause Failure (CCF) are quantified using the scoring process outlined in Annex F of ISO 13849-1. For the purposes of the PL calculation, the required score of 65 needed to fulfill the CCF requirement is considered to be met. The complete CCF scoring process must be done when implementing this example.

SB TLS3 GD2 Interlock Switch	
PL	e
PFH [1/h]	2.47E-8
Cat.	4
MTTFd [a]	100 (High)
DCavg [%]	99 (High)
CCF	65 (fulfilled)

SB POINT Guard I/O: 1734-IB8S	
PL	e
PFH [1/h]	1.34E-10
Cat.	4
MTTFd [a]	*not relevant*
DCavg [%]	*not relevant*
CCF	*not relevant*

SB Safety PLC: Compact GuardLogix 1768	
PL	e
PFH [1/h]	2.1E-10
Cat.	4
MTTFd [a]	*not relevant*
DCavg [%]	*not relevant*
CCF	*not relevant*

SB POINT Guard I/O: 1734-OB8S	
PL	e
PFH [1/h]	1.38E-10
Cat.	4
MTTFd [a]	*not relevant*
DCavg [%]	*not relevant*
CCF	*not relevant*

SB Contactors 100S	
PL	e
PFH [1/h]	2.47E-8
Cat.	4
MTTFd [a]	100 (High)
DCavg [%]	99 (High)
CCF	65 (fulfilled)

Verification and Validation Plan

Verification and Validation play an important role in the avoidance of faults throughout the safety system design and development process. ISO/EN 13849-2 sets the requirements for verification and validation. It calls for a documented plan to confirm all the Safety Functional Requirements have been met.

Verification is an analysis of the resulting safety control system. The Performance Level (PL) of the safety control system is calculated to confirm it meets the Required Performance Level (PLr) specified. The SISTEMA software tool is typically utilized to perform the calculations and assist with satisfying the requirements of ISO 13849-1.

Validation is a functional test of the safety control system to demonstrate that it meets the specified requirements of the safety function. The safety control system is tested to confirm all of the safety related outputs respond appropriately to their corresponding safety related inputs. The functional test should include normal operating conditions in addition to potential fault inject of failure modes. A checklist is typically used to document the validation of the safety control system.

Validation of software development is a process in which similar methodologies and techniques that are used in hardware development are deployed. Faults created through poor software development process and procedure are systemic in nature rather than faults associated with hardware which are considered as random.

Prior to validating the GuardLogix Safety System, it is necessary to confirm the safety system and safety application program have been designed in accordance with the GuardLogix System Safety Reference Manual (1756-RM093) and the GuardLogix Application Instruction Safety Reference Manual (1756-RM095).

GuardLogix Door Monitoring with Safety Lock Function Verification and Validation Checklist		
General Machinery Information		
Machine Name / Model Number		
Machine Serial Number		
Customer Name		
Test Date		
Tester Name(s)		
Schematic Drawing Number		
Controller Name		
Safety Signature ID		
Safety Network Number(s)		
RSLogix5000 Software Version		
Safety Control System Modules	**GuardLogix Modules**	**Firmware Version**
GuardLogix Safety Controller	1768-L43S	
CompactLogix Ethernet Bridge	1768-ENBT	
POINT I/O Ethernet Adapter	1734-AENT	
POINT I/O Input Modules	1734-IB8S	
POINT I/O Output Modules	1734-OB8S	

GuardLogix Safety System Configuration and Wiring Verification			
Test Step	**Verification**	**Pass/Fail**	**Changes/Modifications**
1	Verify the safety system has been designed in accordance with the GuardLogix System Safety Reference Manual 1756-RM093.		
2	Verify the safety application program has been designed in accordance with the GuardLogix Application Instruction Safety Reference Manual 1756-RM095.		
3	Visually inspect the safety system network and I/O is wired as documented in the schematics.		
4	Visually inspect the RSLogix 5000 program to verify that the safety system network and I/O module configuration is configured as documented.		
5	Visually inspect the RSLogix 5000 application program to verify suitable safety certified instructions are utilized. The logic is readable, understandable and testable with the aid of clear comments.		
6	All input devices are qualified by cycling their respective actuators. Monitor the status in the RSLogix 5000 Controller Tags window.		
7	All output devices are qualified by cycling their respective actuators. Monitor the status in the RSLogix 5000 Controller Tags window.		
Normal Operation Verification - The Safety Relay system properly responds to all normal Start, Stop, Estop, Lock and Reset Commands			
Test Step	**Verification**	**Pass/Fail**	**Changes/Modifications**
1	Initiate a Start Command. Both contactors should energize for a normal machine run condition. Verify proper machine status indication and RSLogix 5000 safety application program indication.		
2	Initiate a Stop Command. Both contactors should de-energize immediately for a normal machine Stop condition. After the preset time delay, verify the door unlocks. Verify proper machine status indication and RSLogix 5000 safety application program indication.		
3	While Running, attempt to open the guard door. The door should remain closed and locked. Both contactors should remain energized and closed for a normal safe condition. Verify proper machine status indication and RSLogix 5000 safety application program indication. Repeat for all guard doors.		
4	While Stopped, attempt to open the guard door. The door should be unlocked and able to be opened. Both contactors should remain de-energized and open for a normal safe condition. Verify proper machine status indication and RSLogix 5000 safety application program indication. Repeat for all guard doors.		
5	While Stopped, with the guard door open, initiate a Start Command. Both contactors should remain de-energized and open for a normal safe condition. Verify proper machine status indication and RSLogix 5000 safety application program indication. Repeat for all guard doors.		
7	Initiate Reset Command. Both contactors should remain de-energized. Verify proper machine status indication and RSLogix 5000 safety application program indication.		

Abnormal Operation Verification - The GuardLogix safety system properly responds to all foreseeable faults with corresponding diagnostics. Door Monitoring and Lock Input Tests			
Test Step	**Validation**	**Pass/Fail**	**Changes/Modifications**
1	While Running, remove the Door Monitor Channel 1 wire from the Safety I/O. Both contactors should de-energize. Verify proper machine status indication and RSLogix 5000 safety application program indication. Verify unable to reset and restart with fault. Restore Channel 1 and repeat for Channel 2.		
2	While Running, short the Door Monitor Channel 1 of the Safety I/O to +24VDC. Both contactors should de-energize. Verify proper machine status indication and RSLogix 5000 safety application program indication. Verify unable to reset and restart with fault. Restore Channel 1 and repeat for Channel 2.		
3	While Running, short the Door Monitor Channel 1 of the Safety I/O to (-) 0VDC. Both contactors should de-energize. Verify proper machine status indication and RSLogix 5000 safety application program indication. Verify unable to reset and restart with fault. Restore Channel 1 and repeat for Channel 2.		
4	While Running, short the Door Monitor Channels 1 & 2 of the Safety I/O. Both contactors should de-energize. Verify proper machine status indication and RSLogix 5000 safety application program indication. Verify unable to reset and restart with fault. Restore Channel 1 & 2 wiring.		
5	While Running, short Channel 1 to Test Source 1 of the Safety I/O. Open the guard door. Both contactors should de-energize. Verify proper machine status indication and RSLogix 5000 safety application program indication. Verify unable to reset and restart with fault. Restore Channel 1 and repeat for Channel 2.		
6	While Running, remove the Lock Monitor Channel 1 wire from the Safety I/O. Both contactors should de-energize. Verify proper machine status indication and RSLogix 5000 safety application program indication. Verify unable to reset and restart with fault. Restore Channel 1 and repeat for Channel 2.		
7	While Running, short the Lock Monitor Channel 1 of the Safety I/O to +24VDC. Both contactors should de-energize. Verify proper machine status indication and RSLogix 5000 safety application program indication. Verify unable to reset and restart with fault. Restore Channel 1 and repeat for Channel 2.		
8	While Running, short the Lock Monitor Channel 1 of the Safety I/O to (-)0VDC. Both contactors should de-energize. Verify proper machine status indication and RSLogix 5000 safety application program indication. Verify unable to reset and restart with fault. Restore Channel 1 and repeat for Channel 2.		
9	While Running, short the Lock Monitor Channel 1 &2 of the Safety I/O. Both contactors should de-energize. Verify proper machine status indication and RSLogix 5000 safety application program indication. Verify unable to reset and restart with fault. Restore Channel 1 & 2 wiring.		
GuardLogix Controller and Network Tests			
Test Step	**Validation**	**Pass/Fail**	**Changes/Modifications**
1	While Running, remove the Ethernet network connection between the Safety I/O and the controller. All contactors should de-energize. Verify proper machine status indication and I/O Connection Status in the RSLogix 5000 safety application program.		
2	Restore the Safety I/O module network connection and allow time to reestablish communication. Verify the Connection Status Bit in the RSLogix 5000 safety application program. Repeat for all Safety I/O connections.		
3	While Running, switch the controller out of Run Mode. All contactors should de-energize. Return key switch back to Run Mode, all contactors should remain de-energized. Verify proper machine status indication and RSLogix 5000 safety application program indication.		
Safety Contactor Output Tests			
Test Step	**Validation**	**Pass/Fail**	**Changes/Modifications**
1	Initiate a Start Command. Both contactors should energize for a normal machine run condition. Verify proper machine status indication and RSLogix 5000 safety application program indication.		
2	While Running, remove the contactor feedback from the Safety I/O. All contactors should remain energized. Initiate a Stop command and attempt a Reset command. The system should not Restart or Reset. Verify proper machine status indication and RSLogix 5000 safety application program indication.		
3	While Running, short the contactor feedback to the Safety I/O. All contactors should remain energized. Initiate a Stop command and attempt a Reset command. The system should not Restart or Reset. Verify proper machine status indication and RSLogix 5000 safety application program indication.		
4	While Stopped, remove the safety output to the door lock. The door should remain locked and all contactors should remain de-energized. Verify proper machine status indication and RSLogix 5000 safety application program indication.		

Additional Resources

For more information about the products used in this example refer to these resources.

Resource	Description
Compact GuardLogix Controllers User Manual, Publication 1768-UM002	Provides information on configuring, operating, and maintaining Compact GuardLogix controllers.
POINT Guard I/O Safety Modules Installation and User Manual, Publication 1734-UM013	Provides information on installing, configuring, and operating POINT Guard I/O Modules.
GuardLogix Controller Systems Safety Reference Manual, Publication 1756-RM093	Contains detailed requirements for achieving and maintaining safety ratings with the GuardLogix controller system.
GuardLogix Safety Application Instruction Set Reference Manual, Publication 1756-RM095	Provides detailed information on the GuardLogix Safety Application Instruction Set.
Safety Accelerator Toolkit for GuardLogix Systems Quick Start Guide, Publication IASIMP-QS005	Provides a step-by-step guide to using the design, programming, and diagnostic tools in the Safety Accelerator Toolkit.
Safety Products Catalog	

You can view or download publications at http://www.rockwellautomation.com/literature. To order paper copies of technical documentation, contact your local Allen-Bradley® distributor or Rockwell Automation sales representative.

For More Information on Safety Function Capabilities, visit:

discover.rockwellautomation.com/safety

Rockwell Automation, Allen-Bradley, GuardLogix, RSLogix 5000, CompactLogix, Stratix 2000, and POINT Guard I/O are trademarks of Rockwell Automation, Inc.
Trademarks not belonging to Rockwell Automation are property of their respective companies.

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication SAFETY-AT061B-EN-E – January 2013
Supersedes Publication SAFETY-AT061A-EN-E – October 2012

Copyright ©2013 Rockwell Automation, Inc. All Rights Reserved.